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DYNAMICS OF PLANKTON POPULATIONS IN UPWELLING AREAS

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The following course report summarizes a portion of the ground truth program established in September - October 1972. R.V. "Eastward" was used to measure chlorophyll during the ERTS - 1 overpass. Unfortunately the readjustment of the gray scale in the imagery from ERTS - 1 makes it impossible to recognize plankton (chlorophyll) and/or sediments. Therefore, the digitized tapes will be used to obtain better information.

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Cruise Report

R/V Eastward - E-19 B-72

October 30 - November 5, 1972

Circulation and Chemistry of Shelf and Slope Waters
off the Northeastern United States

Schedule

Departed: Cape Henlopen, Delaware 13:30 30 October, 1972
Arrived: Beaufort, North Carolina 22:30 5 November, 1972

Region Investigated

The major part of the work was confined to two sections. The first (Stations 1-5), called the outward section running roughly southeast from Cape Henlopen to the Sargasso Sea, just beyond the Gulf Stream. The second (Stations 5-10), called the inward section running roughly northwest from the Sargasso Sea to a point close to the mouth of Chesapeake Bay. (Figure 1)

The duration of the cruise was 5 2/3 days with approximately 600 nautical miles steaming and 64 hours of station time.

Eastward Captain

Captain Yeomans

Scientific Party

Mr. Daniel Bottom	University of Delaware
Mr. Charles Brine	University of Delaware
Mr. Thomas Campbell	University of Delaware
Mr. Arthur Flaak	University of Delaware
Ms. Teri Lynn Herbert	Duke University
Mr. Rudy Karp	University of Delaware
Mr. Fred Kelly (Party Chief)	Duke University
Ms. Carolyn Kent	Columbia University (L.G.O.)

Mr. George Kipphut	Columbia University (L.G.O.)
Dr. Stuart Kupferman (Chief Scientist)	University of Delaware
Mr. Frederick K. Lepple	University of Delaware
Mr. Carl Peterson	University of Delaware
Mr. Anthony Pompa	University of Delaware
Dr. Karl-Heinz Szekielda (Co-investigator)	University of Delaware

Scientific Objectives

a) Collection of water samples and insitu collection for Cs-137 (both surface and vertical profile) to determine the distribution of this isotope in shelf and slope waters. Results will be used to determine the applicability of a box model approach for estimating shelf and slope water residence times using Cs-137 and salinity. (Kupferman)

b) Vertical profiles of chlorophyl, phyeophyton, nutrients and silicate to 100 M at stations and continuous monitoring of surface chlorophyl and temperature. Results will be used as ground truth for ERTS satellite overflight. These results, plus salinity and temperature profiles obtained on the cruise will be used to determine the relationship of surface chlorophyl to the vertical distribution of this substance and will enable us to estimate the usefulness of satellite measurements for describing the distribution of chlorophyl in shelf and slope waters. Analyses were carried out for chlorophyl A, pheophyton reactive phosphate, nitrate, nitrite and silicate. (Szekielda and Kupferman)

c) Collection of water for analysis of particulate and dissolved mercury levels to determine the form and distribution of this element in the study area. (Lepple)

d) Surface samples were collected for measurement of radium-228, radium-226, thorium-228, lead-210 and polonium-210. Results of radium-228 (half life 6.7 years) analysis will be used to study the geographic distribution of this isotope to permit its use in testing mathematical models of ocean circulation. Results may also be used with Cs-137 and salinity for box model calculation of the residence time of near surface slope water. Radium-226 is measured to determine the chemical yield of the Radium-228 extraction process. Thorium-228 (half life 1.9 years) is highly reactive in seawater. Knowledge of its distribution permits a prediction of the pathway of other "reactive" pollutants released into the sea from coastal areas. Lead-210 (half life 22 years) and its daughter,

polonium-210 (half life 138 days). Present work with these isotopes consists of the preliminary mapping of their distributions to ascertain whether they may be useful in solving oceanic circulation and transport problems. (Kent and Kipphut)

e) Sampling for atmospheric particulates. The main purpose of this experiment was to evaluate shipboard collecting techniques in preparation for an upcoming IDOE project, off the Northwest Coast of Africa. (Lepple)

Preliminary Results

Sections of salinity, temperature, chlorophyl A, nutrients, and silica are plotted in Figures 2 through 8. Surface salinity and temperature samples were obtained at half hour intervals while the ship was underway. These are plotted in Figures 9 and 10 along with depth, and surface chlorophyl values obtained at stations.

Two interesting features may be observed in these plots. A warm eddy was intercepted in slope water on the outward section. It may be seen most clearly in the temperature section in Figure 8, about 10 nautical miles before station 4. Its surface expression can be seen in the salinity plot in Figure 9. Secondly, we observed a band of freshened water just inshore of the Gulf Stream on both the outward (Northern) and inward (Southern) section. This feature is better developed in the southern section, but can be clearly seen in both the outward and inward salinity sections at stations 4 and 6A (Figures 2 and 5). Water of this type believed to be shelf water, directly entrained in the Gulf Stream. The water type has been described by Ford and Miller (J. Mar. Res. 11, pp. 281-293, 1952). The entrainment process has been observed and recently reported by Fisher (J. Geophys. Res. 77, pp. 3248-3255, 1972).

We were able to obtain nutrient and chlorophyl samples from this water type on both sections and believe that this is the first time that this has been accomplished.

The high chlorophyl values observed in the entrained water on the inward section (Figure 7) are comparable with those we observed in near shore shelf waters.

A listing of stations and activities at each station is given in Table 1. Locations of XBT's are given in Table 2. Complete analysis of remaining samples will require six months to one year. Some results will be available within three months.

Table 1 Summary of Stations

Station No.	Arrival Time (EST)	Date (1972)	Latitude	Longitude	Type of Sampling (See Identification Code Below)	Duration (Hours)
1	15:50	30 Oct.	38°35.9N	74°51.7W	N, Cs-137W, STD, R	1 3/4
2	20:35	30 Oct.	38°12.6N	74°24.0W	NAN, N, Cs-137W, R	1 1/2
3	04:35	31 Oct.	37°26.5N	73°29.2W	NAN, N, Cs-137W, Cs-137I, R, XBT	10 1/2
4	20:08	31 Oct.	37°00.5N	72°59.5W	STD, N, Cs-137W, Sc-137I, R, XBT	10 1/2
4A	10:10	1 Nov.	36°28.4N	72°48.2W	N, R, XBT	1/2
5	14:10	1 Nov.	36°00.0N	72°47.5W	STD, NAN, N, Cs-137W, Co-137I, R, XBT	12 1/2
6	11;25	2 Nov.	36°01.4N	74°06.0W	STD, NAN, N, +NX, Cs-137I, R, XBT	11 1/2
6A	01:05	3 Nov.	36°04.0N	74°04.0W	STD, +NX, XBT	2
7	06:00	3 Nov.	36°14.5N	74°29.9W	STD, NAN, N Cs-137I, R, XBT	10 1/2
8	20:40	3 Nov.	36°21.2N	74°48.9W	STD, NAN, N	1
8A	22:17	3 Nov.	36°22.0N	74°51.2W	STD	1/4
8B	22:51	3 Nov.	36°23.2N	74°51.7W	STD	1/4
9	23:31	3 Nov.	36°25.0N	74°56.1W	STD, N, Cs-137W, R	1/2
10	03:12	4 Nov.	36°41.0N	75°26.0W	STD, N. Cs-137W, R	3/4

N - Nutrients, chlorophyl, pheophyton, silicate and Mercury profile to 100 M using 8L Niskin bottles (+NX means samples were taken instead of or in addition to the standard profile).
Cs-137W - Water samples collected for Cs-137.
Cs-137I - Insitu collection of Cs-137, 17 samples, 10 to 980M

STD - STD Profile
R - Surface sample for radioisotopes Ra-228, RA-226, Pb-210, Th-228.
NAN - Nansen Cast with reversing thermometers
XBT - Expendable bathythermograph

Table 2

X B T ' S

Consecutive Number	Day (1972)	Time (EST)	Latitude	Longitude
56	31 Oct.	01:35	37°47.5N	73°54.5W
57	31 Oct.	02:53	37°40.5N	73°45.5W
58	31 Oct.	03:30	37°33.5N	73°37.0W
59	31 Oct.	04:35	37°26.5N	73°29.2W
60	31 Oct.	16:43	37°18.5N	73°25.0W
61	31 Oct.	17:50	37°11.9N	73°16.0W
62	31 Oct.	18:52	37°05.0N	73°07.1W
63	31 Oct.	21:27	37°00.5N	72°59.2W
64	1 Nov.	06:27	37°00.9N	72°58.6W
65	1 Nov.	08:05	36°46.2N	72°44.2W
66	1 Nov.	08:55	36°38.4N	72°51.8W
67	1 Nov.	10:07	36°28.2N	72°48.2W
68	1 Nov.	12:30	36°15.1N	72°46.2W
69	1 Nov.	14:10	36°00.0N	72°47.5W
70	2 Nov.	02:34	36°01.0N	72°58.2W
71	2 Nov.	06:13	36°02.5N	73°18.5W
72	2 Nov.	09:08	36°02.5N	73°42.5W
73	2 Nov.	11:35	36°01.4N	74°06.0W
74	2 Nov.	13:30	36°02.0N	74°05.5W
75	2 Nov.	15:30	36°02.0N	74°05.0W
76	2 Nov.	23:26	36°01.8N	73°58.5W
77	3 Nov.	00:35	36°04.0N	74°04.0W
78	3 Nov.	02:40	36°04.0N	74°04.0W
79	3 Nov.	06:13	36°14.5N	74°29.9W
80	3 Nov.	16:15	Bad	XBT
81	3 Nov.	16:24	36°08.7N	74°28.6W
82	3 Nov.	18:42	36°19.5N	74°46.6W

Note: XBT's 67 and 78 were 450M all the rest were 750M.

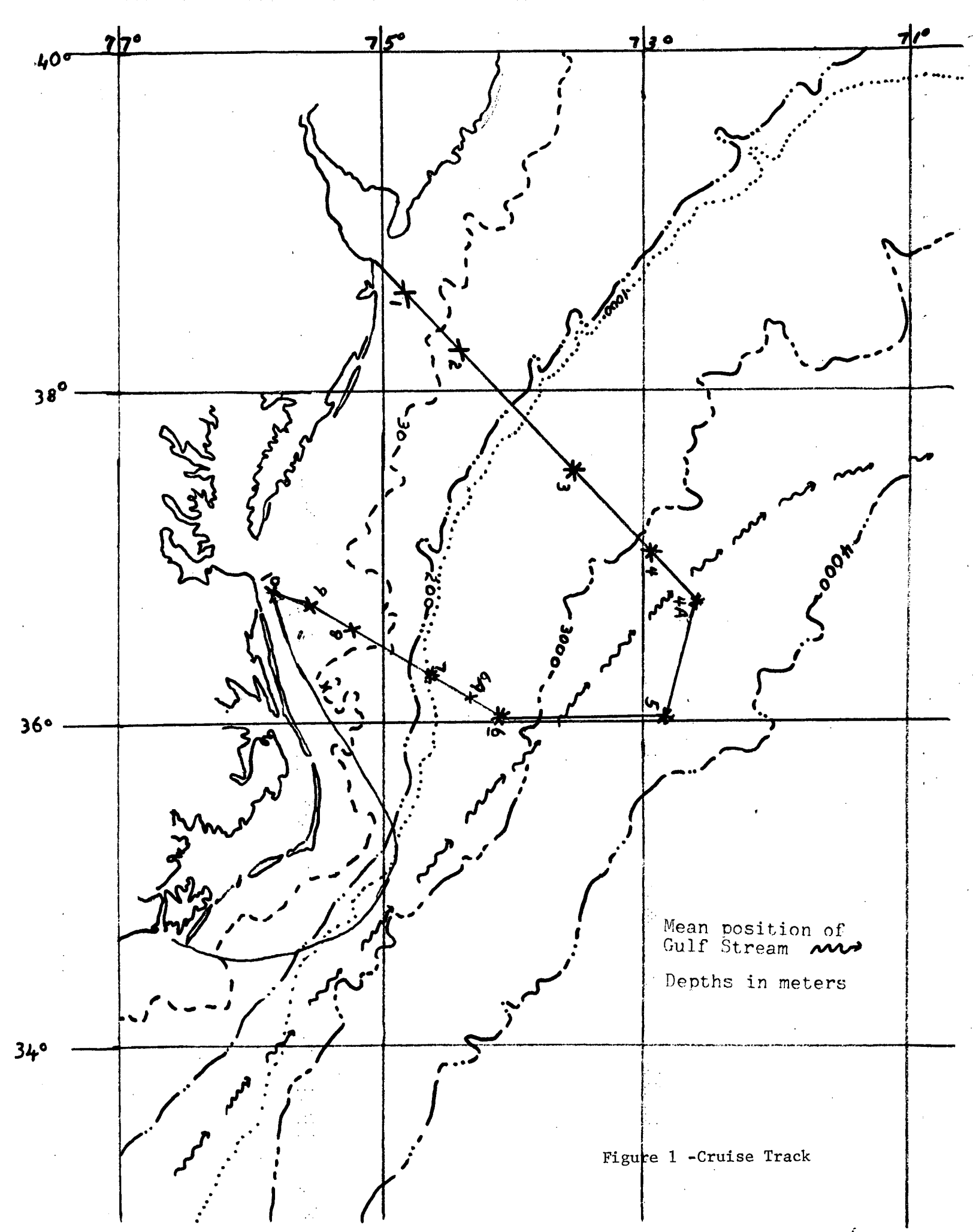

Figure 1 -Cruise Track

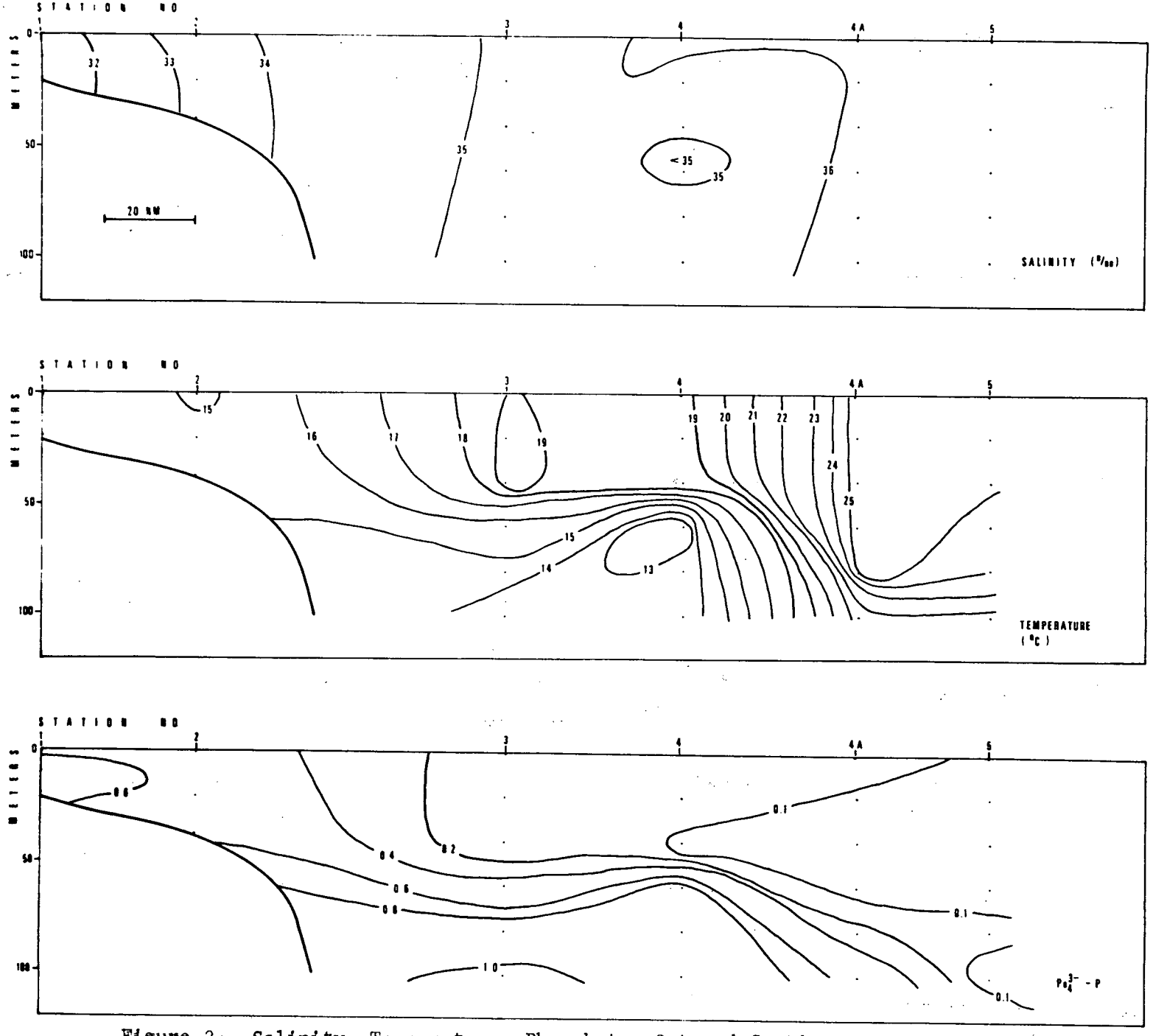

Figure 2: Salinity, Temperature, Phosphate, Outward Section

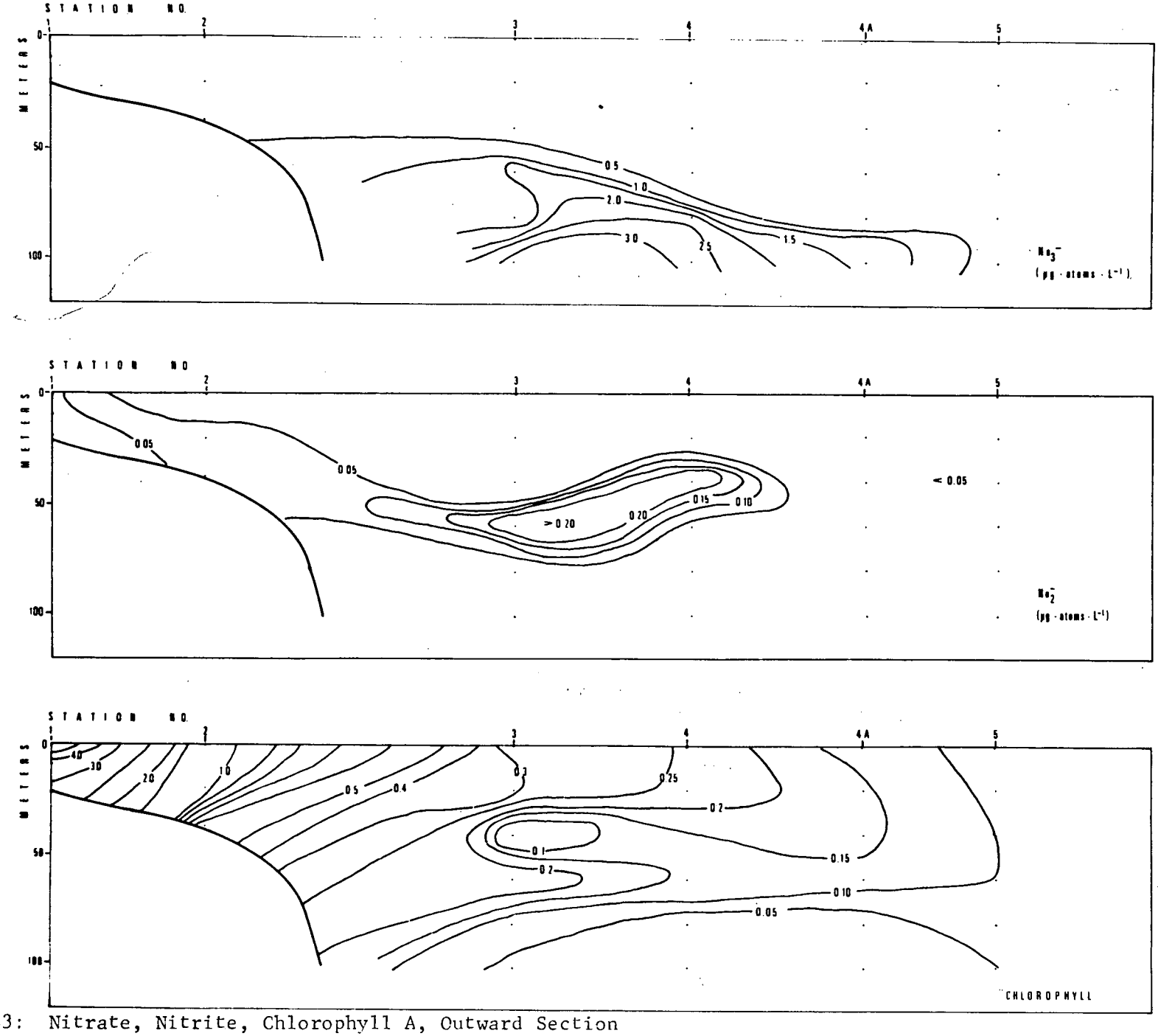

Figure 3: Nitrate, Nitrite, Chlorophyll A, Outward Section

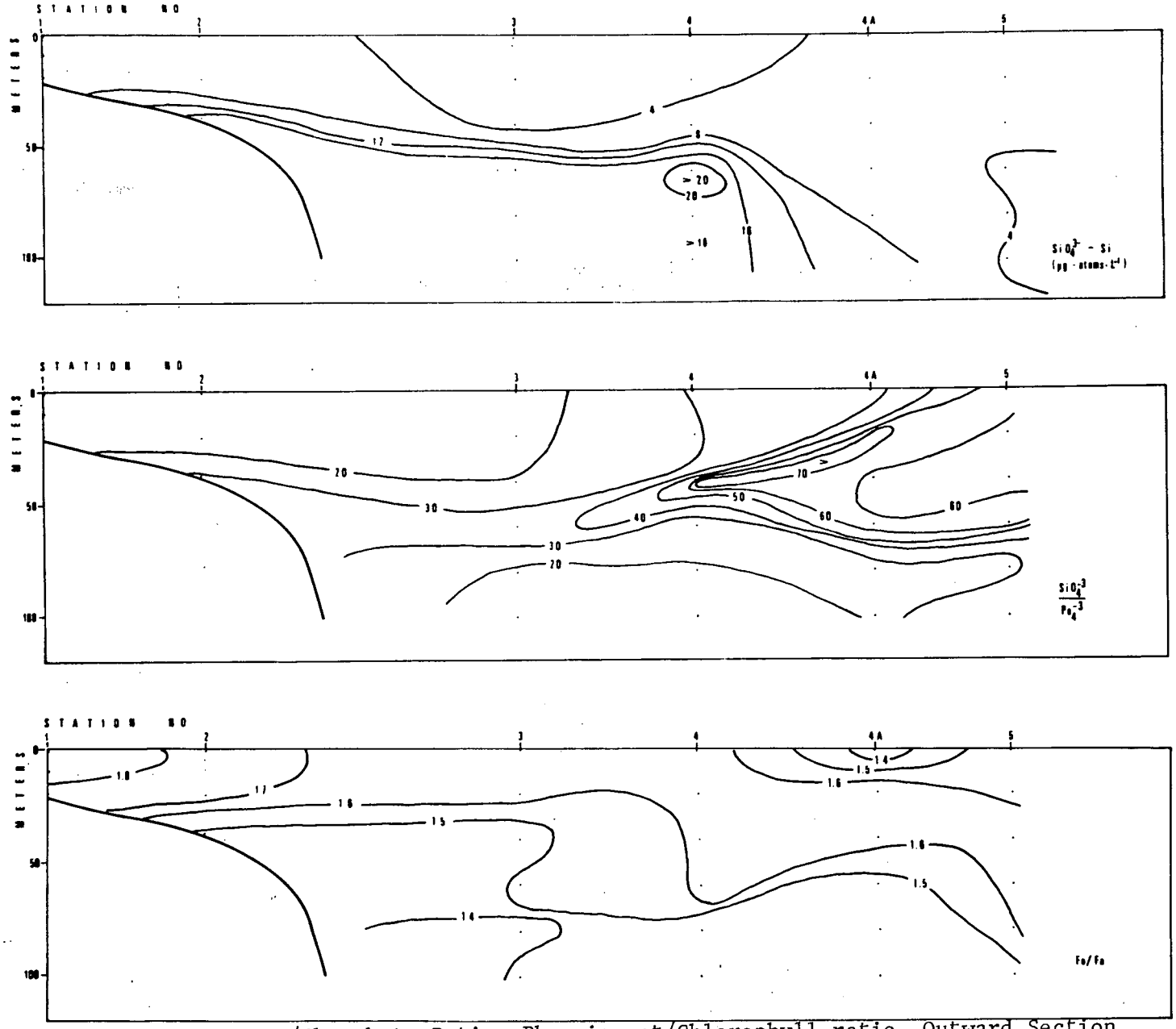

Figure 4: Silicate, Silicate/Phosphate Ratio, Pheopigment/Chlorophyll ratio, Outward Section

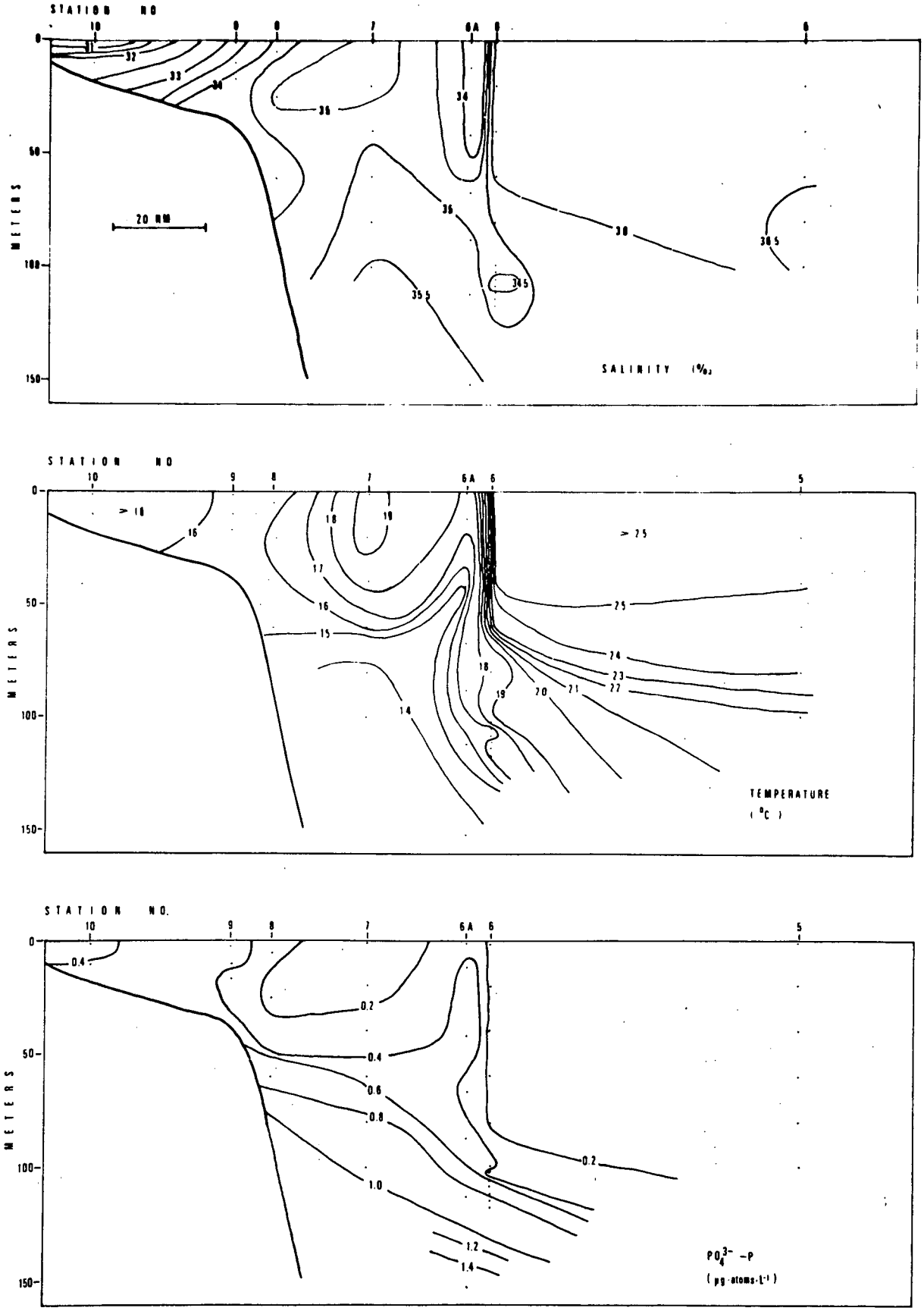

Figure 5: Salinity, Temperature, Phosphate, Inward Section

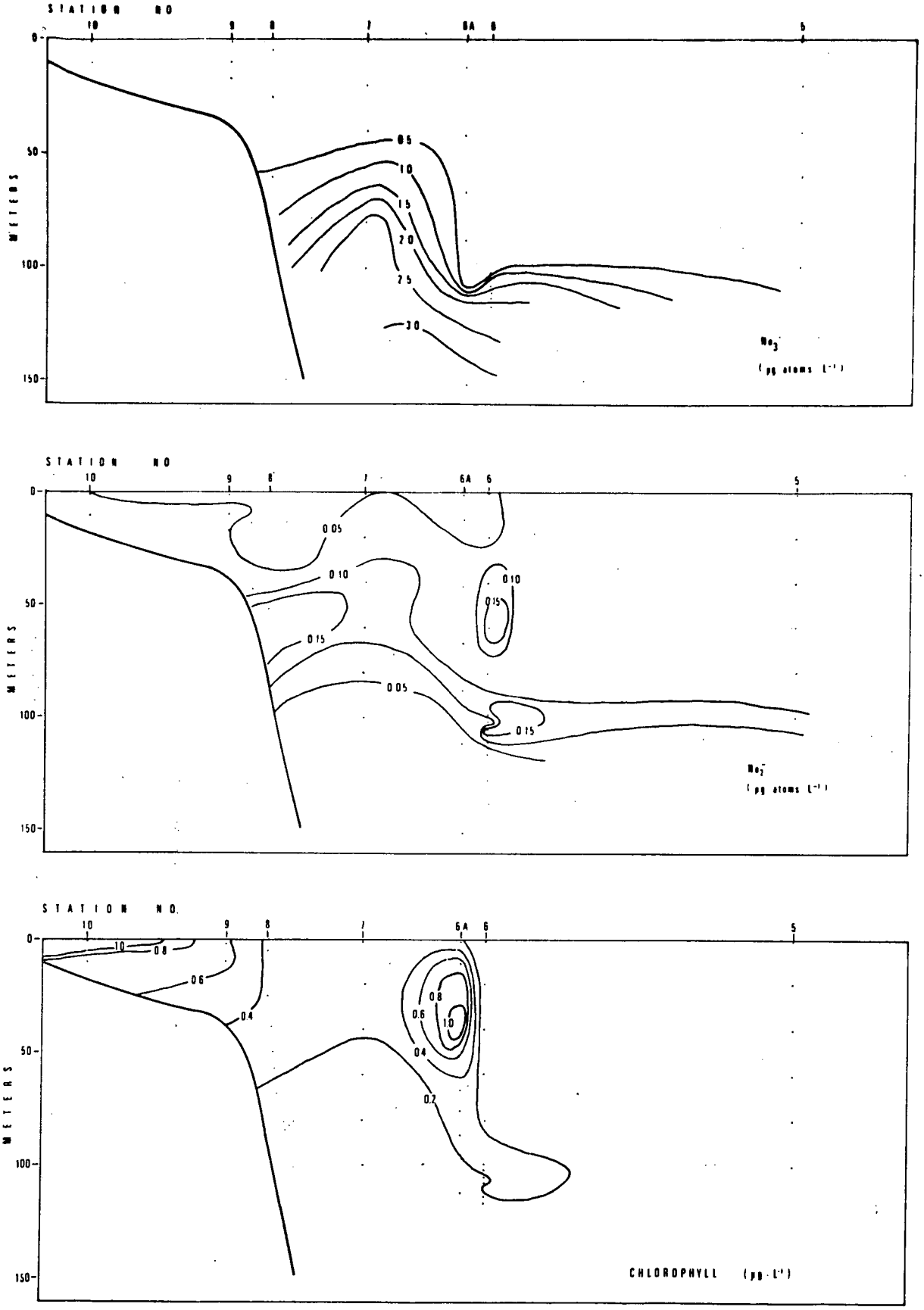

Figure 6: Nitrate, Nitrite, Chlorophyll A, Inward Section

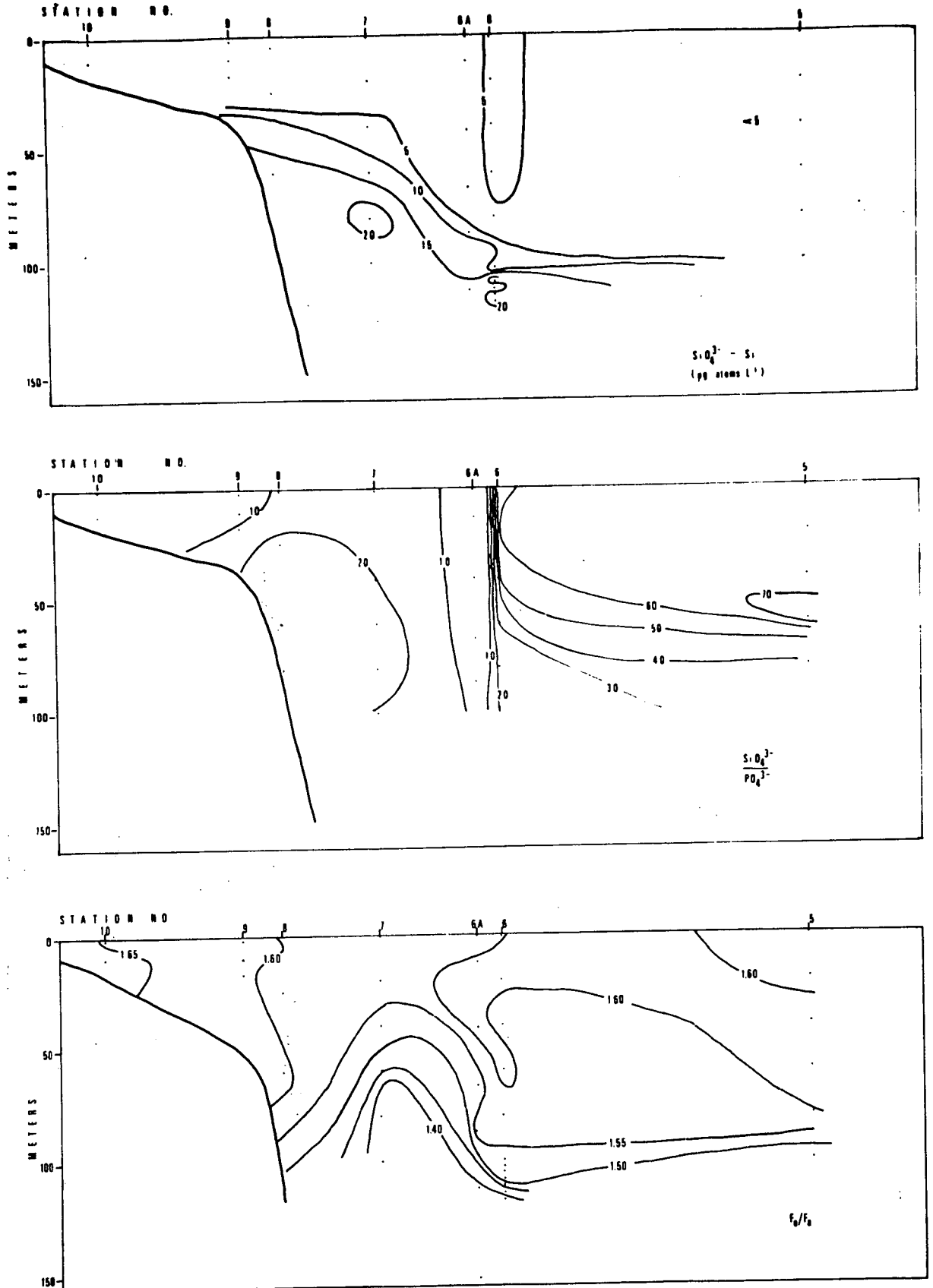

Figure 7: Silicate, Silicate/Phosphate Ratio, Pheopigment/Chlorophyll Ratio Inward Section

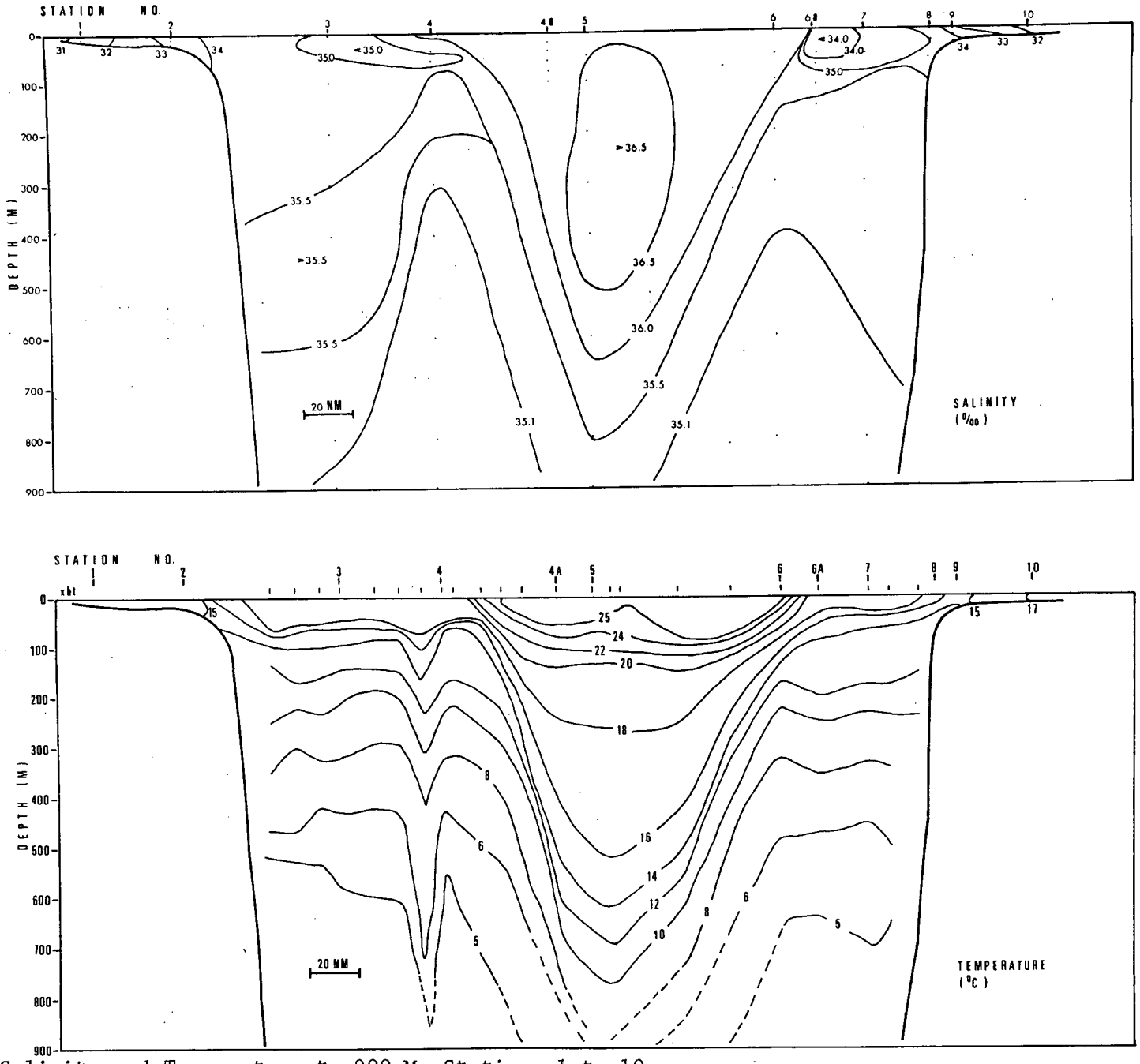

Figure 8: Salinity and Temperature to 900 M, Stations 1 to 10.

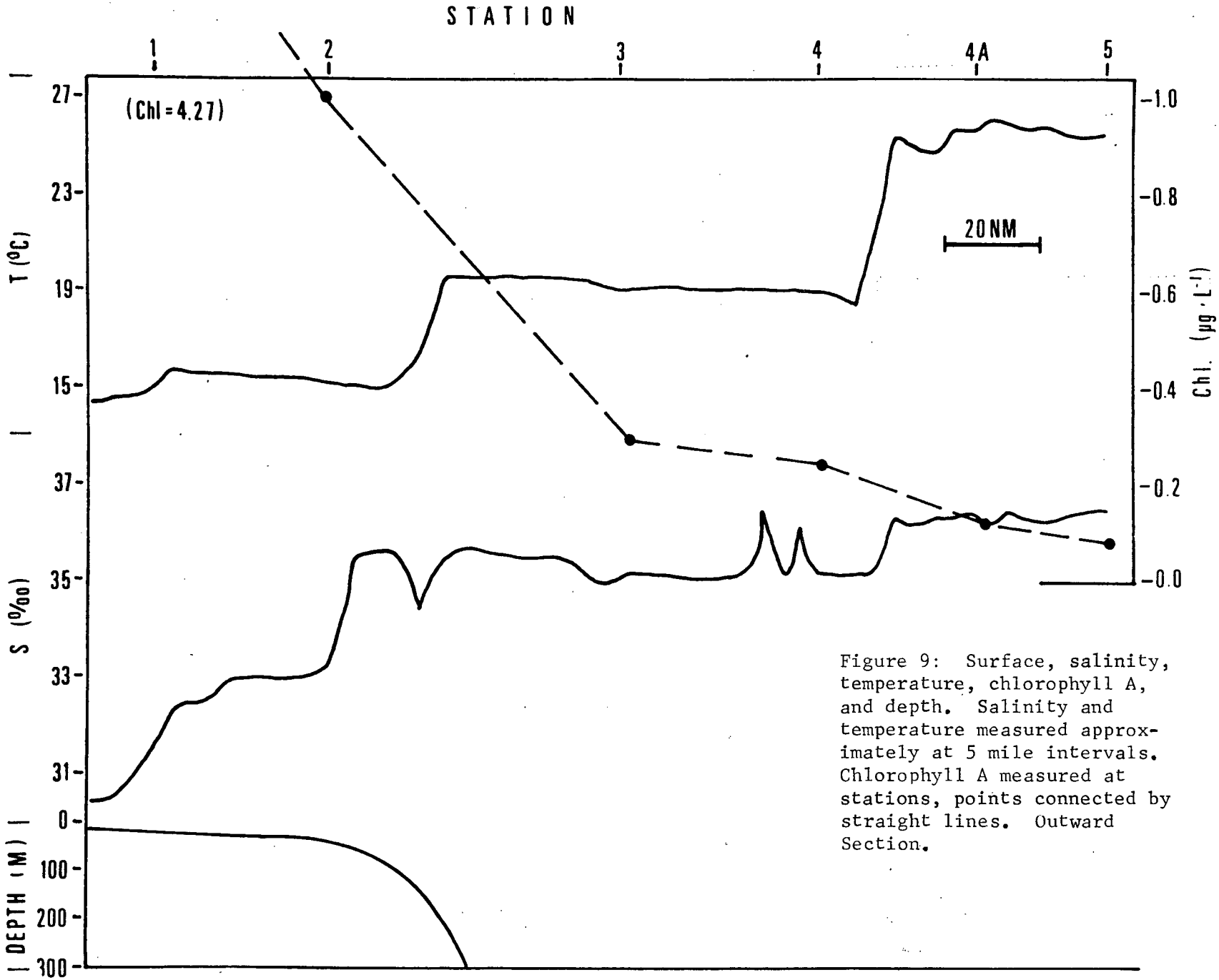

Figure 9: Surface, salinity, temperature, chlorophyll A, and depth. Salinity and temperature measured approximately at 5 mile intervals. Chlorophyll A measured at stations, points connected by straight lines. Outward Section.

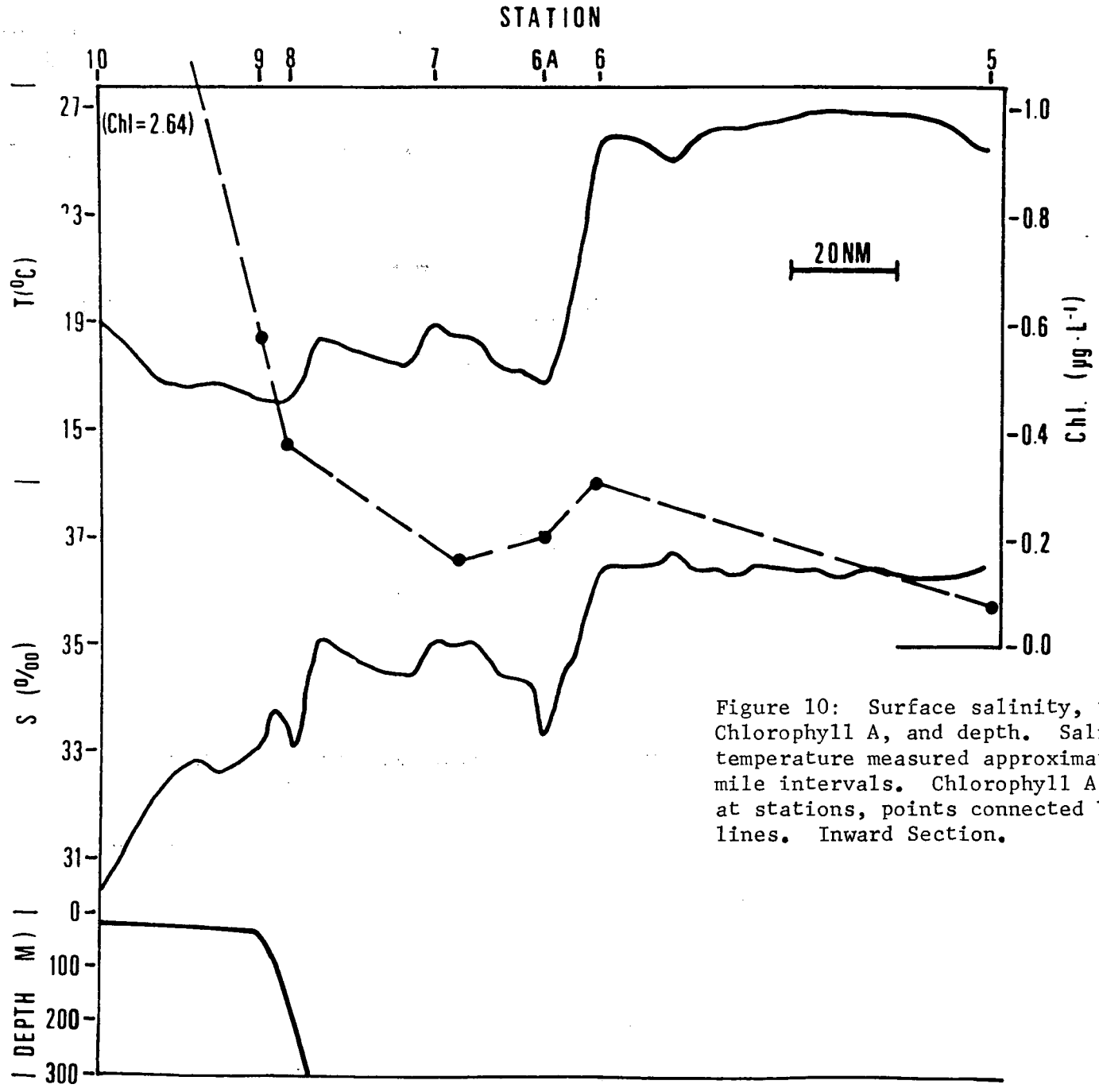

Figure 10: Surface salinity, temperature, Chlorophyll A, and depth. Salinity and temperature measured approximately at 5 mile intervals. Chlorophyll A measured at stations, points connected by straight lines. Inward Section.